Agriculture and Agrifoods - PlotCam Lite

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1 Introduction

Monitoring growth is an essential facet of managing crops. It allows farmers to make changes to the crops when needed and harvest the crops at the correct time to ensure optimal yield. The Plot Cam Lite (PCL) is an affordable solution to human-operated plant monitoring experiments. The design of this device is based on the original Plot Cam developed by Marc Lefebvre. The PCL uses a depth camera and a high resolution accelerometer to take Red Green Blue (RGB) and depth images of plants plots.

1.1 Key Features:

- User friendly
- Developed using PyQt5 and pyrealsense libraries
- Compatible with Intel Realsense D415 and PhidgetSpatial Precision 3/3/3 Accelerometer
- Easy camera configuration of FPS and resolution

2 In the Box

The items included in the PCL are listed below:

- Intel Realsense D415
- PhidgetSpatial Precision 3/3/3 High Resolution
- VR Head Set
- 1x USB C Cable
- 2x USB B Cables

3 Technical Specifications

Part	Component	Rating
Depth Camera	Model	Intel RealSense D415
	Ideal Range	0.5m to 3m
	Use Environment	Indoor/Outdoor
	Image Sensor Technology	Rolling Shutter
	Depth Technology	Active IR Stereo
	Depth Accuracy	2% at 2m
	Depth Frame Rate	30, 60, 90 FPS
	Depth Output Resolution	640x480, 1280×720
	RGB Sensor Technology	Rolling Shutter
	RGB Frame Resolution	1920×1080
	RGB Frame Rate	15, 30 FPS
	Connector	USB-C 3.1
	Dimensions	99 mm × 20 mm × 23 mm
Accelerometer	Model	PhidgetSpatial 3/3/3 High Resolution
	Acceleration Measurement Max	± 2g
	Acceleration Measurement Resolution	76.3 µg
	Acceleration Bandwidth	497 Hz
	Accelerometer White Noise	280 µg
	Accelerometer Minimum Drift	40.6 µg
	Accelerometer Optimal Averaging Period	398s

Table 1: Technical Specifications of the Hardware Components of the PCL

4 Requirements

The minimum requirements for running the software required to operate the Plot Cam Lite are listed below:

- Microsoft Windows 10 or above
- Python 3.9 or above
- Phidget libraries.
- 2x USB A 3.0 ports
- 1x USB C 3.0 port

5 Getting Started

5.1 Hardware

Follow the steps below to set up the hardware of the Plot Cam Lite.

1. Connect the VR Headset through HDMI to your PC.
2. Connect the Phidget accelerometer through USB A to PC
3. Connect a wireless air mouse through USB to the PC
4. Connect the Intel camera through USB C to the PC

The hardware connections of the components of the PCL are shown in Figure 1.

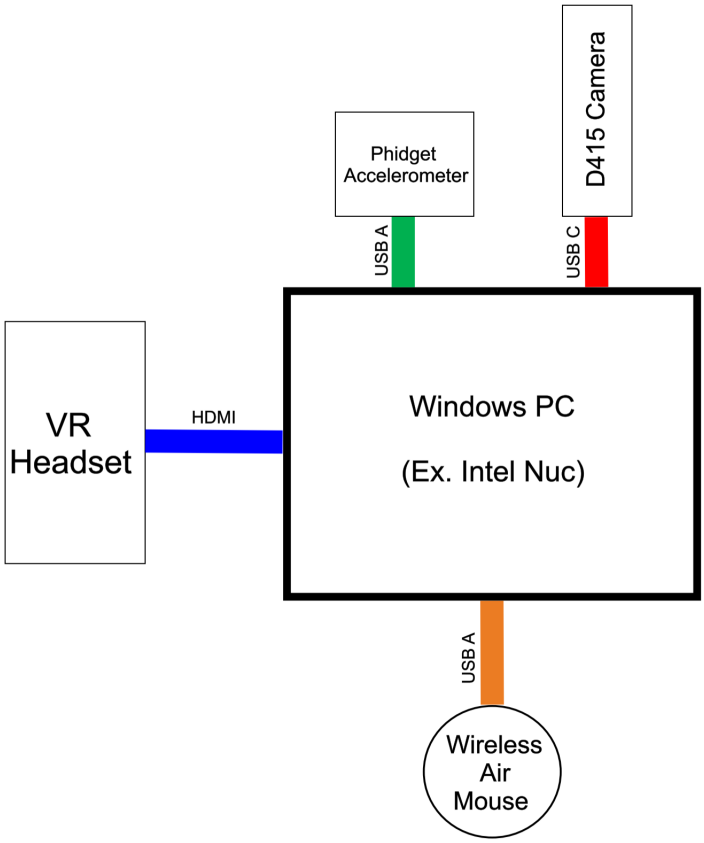
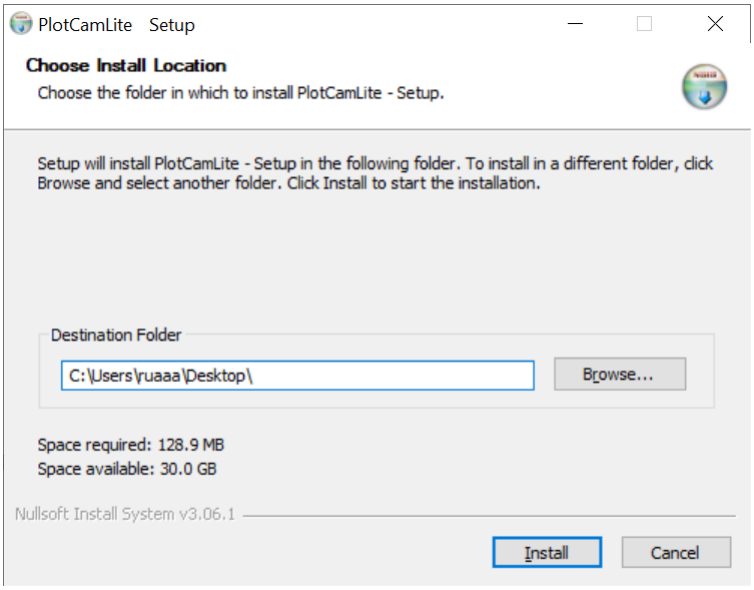


Figure 1: PCL Hardware Connections

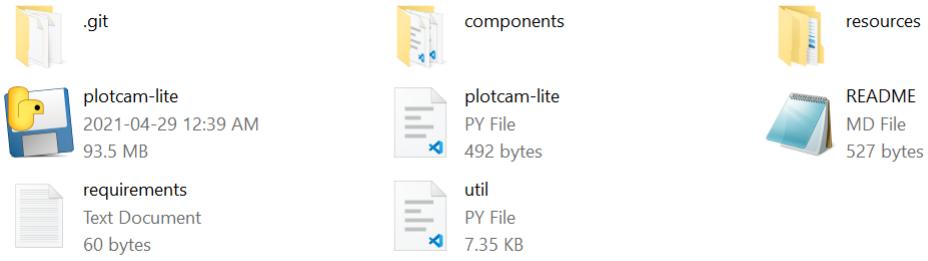
5.2 Software

Follow these steps to install and set up the Plot Cam Lite program on your machine.

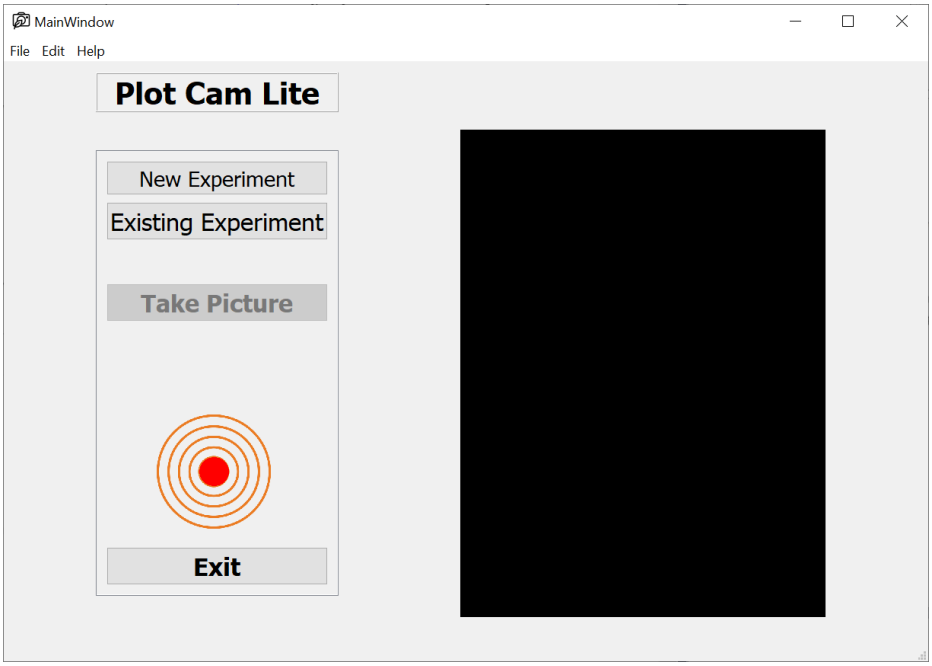
1. Follow this link and download PlotCamLite.exe
2. Open the file, note that an error about an unknown publisher might pop up, click 'More Info' and "Run Anyway".
3. Choose a destination folder for the program, such as Desktop, and click 'Install'. This directory will be used to launch the program as well as access camera data. Ensure that the chosen directory does not contain a folder with the same name as the program.



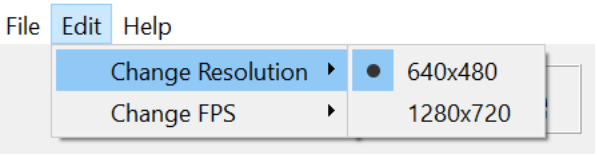
4. Once the install is complete, close the setup pop up and head over to the directory the program was just saved in. The folder will contain the following files.

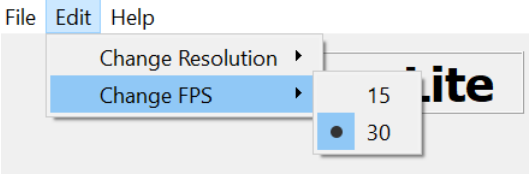


5. To start the program, open the 'plotcam-lite.exe' file. A new folder will be created within the directory titled 'Experiments'. This folder will be used to store the camera data of each experiment.



6. The resolution and Frames per Second (FPS) can be configured using the edit menu in the top-left options bar. The default (and optimal) stream is set at 1280x720 and running at 30 FPS.





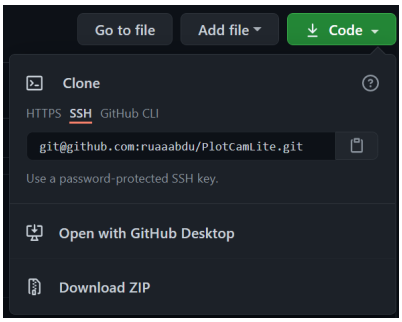
7. To access documentation for the PCL, go to Help → Documentation.

6 Getting Started - For Developers

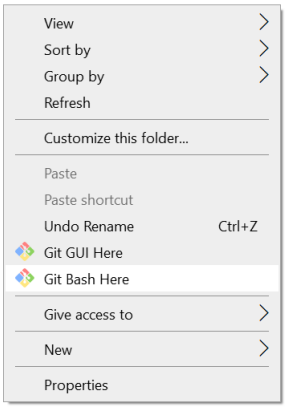
6.1 Set Up Repository

Follow theses steps to set up a respository of the Plot Cam Lite on your computer.

1. Install the GitBash on your PC from here.
2. Set up SSH by following the steps on this page.
3. On the GitHub repository, there is a green button marked 'Code'. Once its clicked, select the SSH link as shown below.



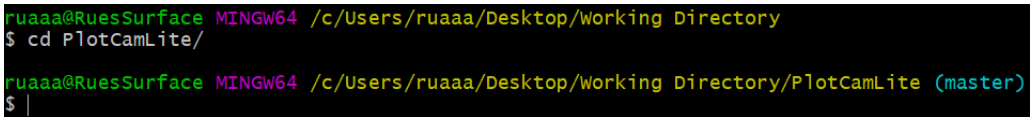
4. Go to the directory you want to have the repository in, right click and select 'Git Bash Here'

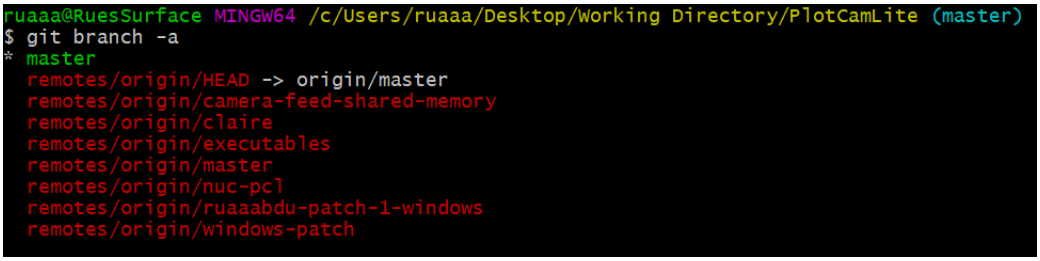


5. In the terminal window that comes up, type **git clone** followed by the SSH link from the last step and press enter.

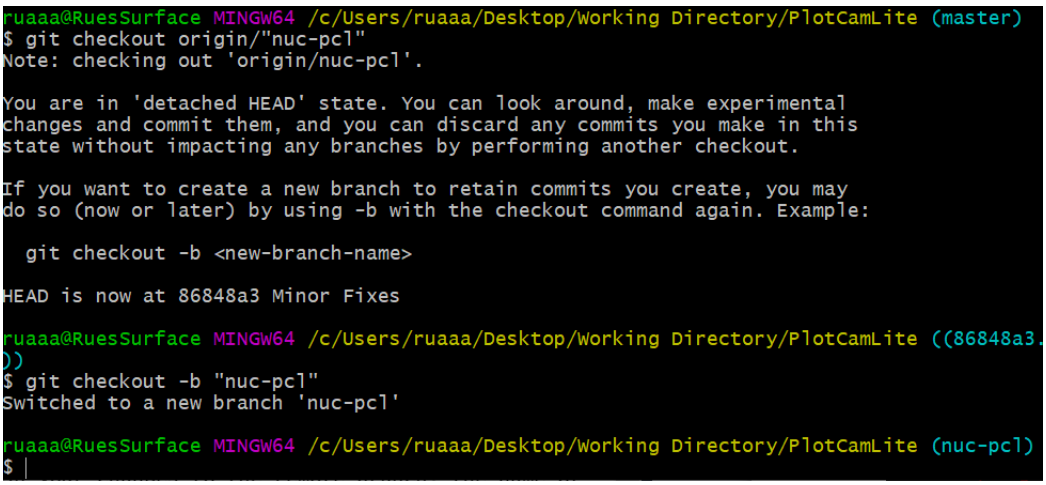
```
ruaaa@RuesSurface MINGW64 /c/Users/ruaaa/Desktop/Working Directory
$ git clone git@github.com:ruaaabdu/PlotCamLite.git
Cloning into 'PlotCamLite'...
remote: Enumerating objects: 405, done.
remote: Counting objects: 100% (222/222), done.
remote: Compressing objects: 100% (166/166), done.
remote: Total 405 (delta 125), reused 104 (delta 52), pack-reused 183
Receiving objects: 100% (405/405), 34.23 MiB | 3.65 MiB/s, done.
Resolving deltas: 100% (212/212), done.
```

6. Type **cd PlotCamLite/** to go into the repository folder.
7. It is not good practice to work directly off master. Choose a branch or create one to work within. Once you are sure of your changes, push them to master. To see a list of available remote and local branches, type **git branch -a**.





8. To get into one of the branches, type **git checkout origin/"branch-name"**, as below. This copies the contents of the branch repository onto your local repository, but it creates a new pointer. In order to push your changes to the remote branch, the name of your local branch must match the name of the remote branch, type **git checkout -b "branch-name"**



Your local repository is now up to date with the latest version of the chosen branch. If using an IDE which supports Git source control, such as VSCode, there are simple ways to pull changes from the remote branch and push changes from your local branch straight from the IDE. For VSCode, more information on Git can be found here. A GitHub cheatsheet can be found here.

6.2 Install Dependencies

To install the dependencies required for the program, install all the libraries found in requirements.txt by using **pip install *library-name***

6.3 Access CMD Options

This version supports options which can be accessed through the command terminal. To access these options, navigate to the folder containing the repository and type cmd in the box with the file path to open the terminal at that location. These options allow you to format properly on a monitor, configure resolution and FPS, and see logs as they happen for debugging.

- Type **python plotcam-lite.py -h** to see all the available options.

```
C:\Users\ruaaa\Desktop\Working Directory\PlotCamLite>python plotcam-lite.py -h
usage: python plotcam-lite.py [-h] [-monitor] [-res {1280,640}] [-fps {15,30}] [-l {debug,info,warning,error}]

PlotCamLite (April 2021). Realtime plot monitoring system. By Rua'a Abdulmajeed for AAFC Phenom Corp

optional arguments:
  -h, --help            show this help message and exit
  -monitor              add this option for it to format properly on a monitor
  -res {1280,640}       change the stream's resolution, either 1280x720(default) or 640x480
  -fps {15,30}          set the stream's fps, either 15 or 30
  -l {debug,info,warning,error}, --log {debug,info,warning,error}
                        specify level of logging, defaults to no logging
```

6.4 Edit UI of Main Window and 'About' Window

In order to make UI changes to the main window or the Help → About window, install Qt Designer and edit the .ui files found in resources/UI.

6.5 Edit 'Take Picture' Shutter Sound

Save the .wav file of the sound to the resources/audio file. In *util.py*, edit the **ALERT_AUDIO_PATH** variable to specify the new .wav file.

```
ALERT_AUDIO_PATH = os.path.join(PCL_SRC_PATH, "resources", "audio", "camera-shutter-click.wav")
```

6.6 Build Executable

1. Install pyinstaller by typing **pip install pyinstaller** in cmd.
2. In cmd, navigate to the directory of your repository by typing **cd *repo-file-path***.
3. Type **pyinstaller –onefile -w plotcam-lite.py** to create an executable which will launch directly as a Windows program. Without the **-w** tag, the command creates an executable which boots up with a command script then launches a Windows program. The second option is helpful for debugging issues.
4. In the repository, there will be new 'dist' and 'build' folders, move the executable file from 'dist' up one level to the main directory. delete dist, build and the '.spec' file. Once clicked, the executable will launch the program.
5. In order to package up all the files into a single install file for distribution, download and launch NSIS from here. Use all default settings.
6. Create a compressed copy of the repository and load it into NSIS by selecting "Installer based on .ZIP file".
7. Wait for files to load then click generate.
8. Once prompted, save the installer file on your computer.

Acronyms

FPS Frames per Second. 7, 9

IDE Integrated Development Environment. 9

IR Infrared. 4

PCL Plot Cam Lite. 3–8

RGB Red Green Blue. 3

UI User Interface. 10